MAP4C1 Unit 1: Trigonometry

# 1.7 Applications of the Sine and Cosine Law

Learning Goals: I am learning to…

- ☐ Solve application based problems involving the Sine and Cosine Law
- ☐ Apply a variety of trigonometry solving techniques to real-world problems
- ☐ Identify when to use different trigonometry skills

**Primary Trig Ratios:**

$\sin\theta = \frac{opp}{hyp}$ (SOH)

$\cos\theta = \frac{adj}{hyp}$ (CAH)

$\tan\theta = \frac{opp}{adj}$ (TOA)

**Pythagorean Theorem:**

$a^2 + b^2 = c^2$

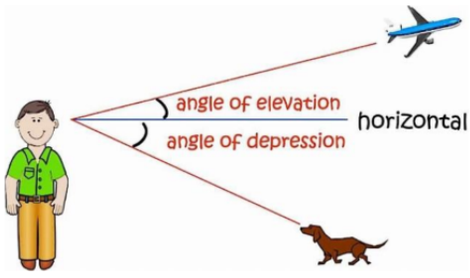
*c is always the longest side (hypotenuse)

**Sum of Interior Angles:**

$< A + < B + < C = 180°$

**Angle of Elevation (Inclination):**
The angle formed by the horizontal and the line of sight to an object **above** the horizontal.

**Angle of Depression:**
The angle between the horizontal line and the line of sight to an object **below** the horizontal.




**Sine Law:**

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

**Cosine Law:**

$$c^2 = a^2 + b^2 - 2ab\ \cos C$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Trigonometric application problems can be solved by applying a variety of different skills and problem solving techniques.

1. Sketch a well-labeled diagram to model the situation (if appropriate).
2. Apply the appropriate trig strategy or strategies to solve.
   - Pythagorean Theorem $a^2 + b^2 = c^2$
   - Sum of angles is equal to 180°
   - Primary trig rations – (SOH CAH TOA)
   - Sine or cosine law
3. Conclude the problem and explain what the solution means, including units!

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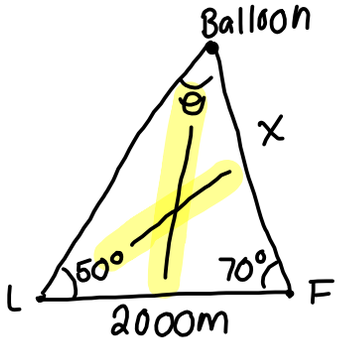
**Example 1:** Lynn and Fred standing 2000 m apart, spotted a hot air balloon at angles of elevation of 50° and 70° respectively. The hot air balloon is located between them. What is the distance from Fred directly to the hot air balloon? Show all your work.

Law used: Sine




let x rep. the distance from Fred to the balloon.

① $\theta = 180° - 50° - 70°$
$= 60°$

② $\frac{x}{\sin 50°} = \frac{2000}{\sin 60°}$

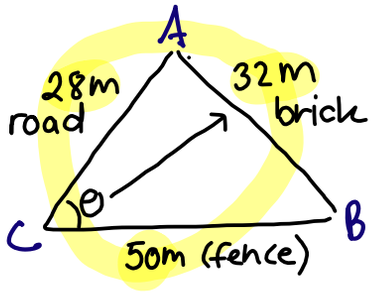
$\frac{x(\sin 60°)}{\sin 60°} = \frac{2000(\sin 50°)}{\sin 60°}$

$x = 1769.1\text{ m}$

∴ The distance between Fred and the balloon is 1769.1m

**Example 2:** A triangular piece of land is surrounded by 32 m of brick wall, 50 m of fencing, and 28 m of road frontage. What angle does the fence make with the road? Show all your work!

Law used: Cosine




let θ rep. the angle between the fence and the road.

$\cos C = \frac{a^2+b^2-c^2}{2ab}$

$\cos\theta = \frac{28^2+50^2-32^2}{2(28)(50)}$

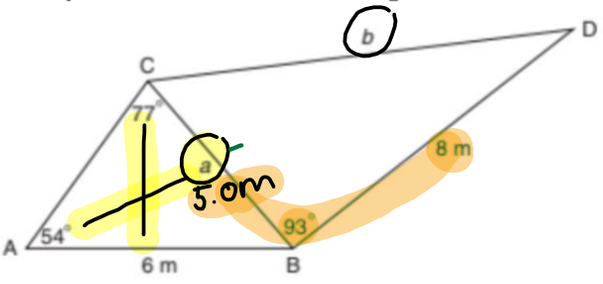
$\cos\theta = \frac{2260}{2800}$

$\theta = \cos^{-1}\left(\frac{2260}{2800}\right)$

$\theta = 36.2°$

∴ The angle of the road with the fence is 36.2°.

**Example 3:** Determine side lengths, a and b. Round to one decimal place.




① Side a:

$\frac{a}{\sin A} = \frac{c}{\sin C}$

$\frac{a}{\sin 54°} = \frac{6}{\sin 77°}$

$\frac{a(\sin 77°)}{\sin 77°} = \frac{6(\sin 54°)}{\sin 77°}$

$a = 5.0\text{m}$

② Side b:

$b^2 = a^2 + c^2 - 2ac\cos B$

$b^2 = 5.0^2 + 8^2 - 2(5.0)(8)\cos 93°$

$b^2 = 25 + 64 - 80\cos 93°$

$b^2 = 89 - (80\cos 93°)$

$b^2 = 93.19$

$b = 9.7\text{m}$